Inspector

OPERATION MANUAL

RADIATION® A•L•E•R•T

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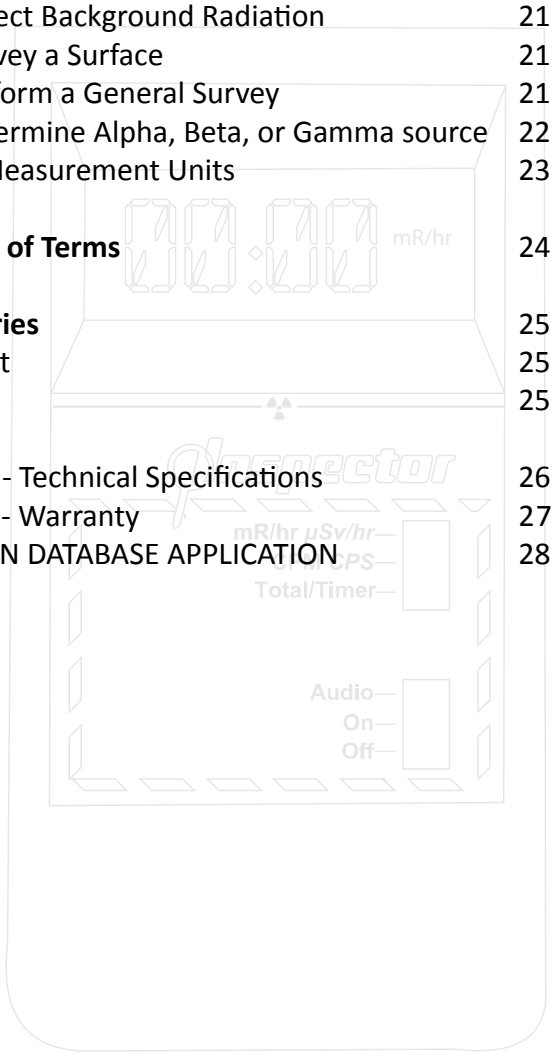


Chapter 1: Introduction

The Inspector is a health and safety instrument that is optimized to detect low levels of radiation. It measures alpha, beta, gamma, and x-ray radiation (ionizing radiation only).

Its applications include:
• Detecting and measuring surface contamination
• Monitoring possible radiation exposure while working with radionuclides
• Screening for environmental contamination
• Detecting noble gases and other low energy radionuclides

How The Inspector Detects Radiation

The Inspector uses a Geiger-Mueller tube to detect radiation. The Geiger tube generates a pulse of electrical current each time radiation passes through the halogen quenched tube and causes ionization. Each pulse is electronically detected and registers as a count. The Inspector displays the counts in the mode you choose.

The number of counts detected by The Inspector varies from minute to minute due to the random nature of radioactivity. A reading is expressed more accurately as an average over time, and the average is more accurate over a longer time period. *For details, see "Operating in Timer Mode" in Chapter 3.*

Precautions

To keep the Inspector in good condition, handle it with care, and observe the following precautions:
• CAUTION: Never touch the Inspector to a surface that may be contaminated. You may contaminate the instrument.
• Do not leave the Inspector in temperatures over 100° F (38° C) or in direct sunlight for extended periods of time.
• Do not get the Inspector wet. Water can damage the circuitry and the mica surface of the Geiger tube.
• Do not put the Inspector in a microwave oven. It cannot measure microwaves, and you may damage it or the oven.
• This instrument may be sensitive to and may not operate properly in radio frequency, microwave, electrostatic, and electromagnetic fields.
• If you do not expect to use The Inspector for longer than one month, remove the battery to avoid damage from battery corrosion. Change the battery promptly when the battery indicator appears on the display.
• CAUTION: When using the unit at altitudes higher than 8000 feet (2438.4 meters), it is possible that the tube window can rupture.

Chapter 2: Features

The Inspector measures alpha, beta, gamma, and x-ray radiation. It is optimized to detect small changes in radiation levels and to have high sensitivity to many common radionuclides. *For more information, see Appendix A, "Sensitivity to Common Radionuclides."* This chapter briefly describes The Inspector's functions. For more information on how to use the Inspector, see Chapter 3: Operation. The Inspector counts ionizing events and displays the results on the liquid crystal display (LCD). You control which unit of measurement is shown by using the mode switch. Whenever the Inspector is operating, the red count light (8) flashes each time a count (an ionizing event) is detected.

The LCD Display *Figure 2 (1)*

The LCD *(liquid crystal display. Figure 1)* shows various indicators according to the mode setting, function(s) being performed, and battery condition as shown below.

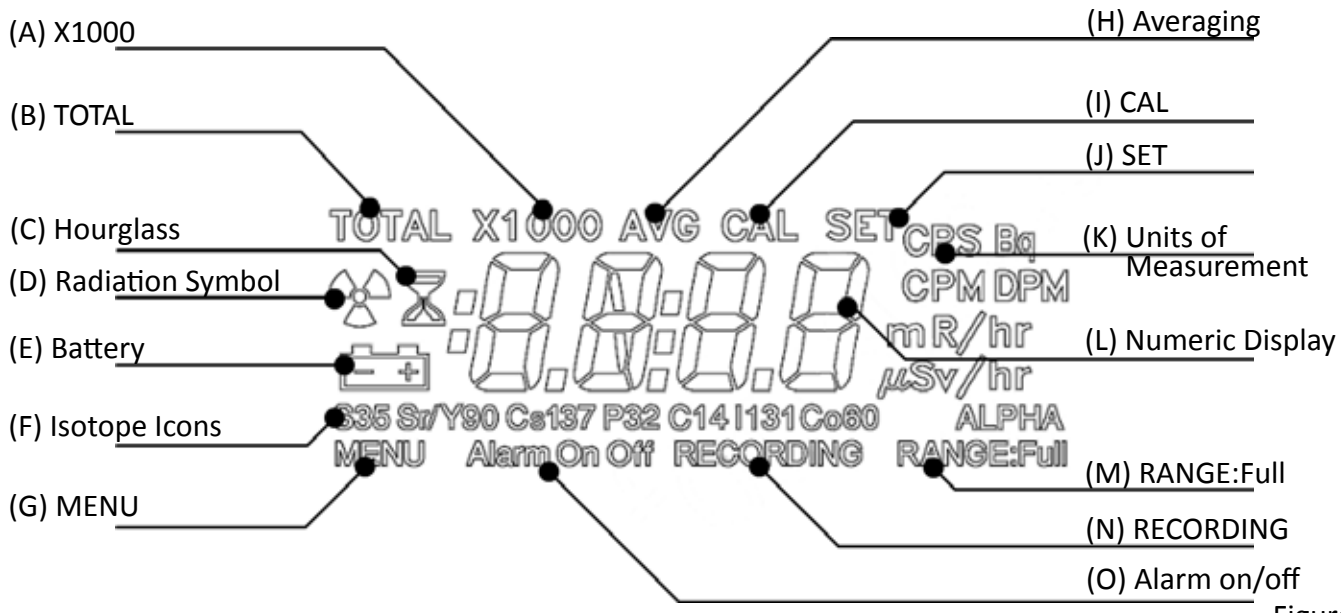


Figure 1

Indicators:

- X1000 (A) appears when the numeric display is to be multiplied by 1000.
- TOTAL (B) appears when The Inspector is in Total/Timer mode.
- An hourglass (C) appears to the left of the numeric display while in the Cal mode or during a timed count.
- A Radiation Symbol (D) Appears to the left of the numeric display when the Alert mode is activated.
- A Battery Icon (E) appears to the left of the numeric display indicating low battery voltage.
- The Isotope Icons (F) identify the user selected isoptope efficiency for calculating activity. (See Chapter 9: Built in Isotope Efficiencies)
- MENU (G) appears upon entering the menu.
- Averaging (H) appears when switching between Auto-Averaging and Fast Response mode.
- CAL (I) is shown while you are calibrating the Inspector.
- SET (J) appears when you are setting the timer (the numeric display shows the timed period instead of the current radiation level) and while adjusting settings in the Utility and Alarm Menus.
- The current unit of measurement (K)—CPM, CPS, mR/hr, µSv/hr, Bq, or DPM—is displayed to the right of the numeric display.
- The Numeric Display (L) shows the current radiation level in the unit specified by the mode switch setting.
- RANGE:Full (M) appears when the radiation present exceeds the upper detection limit of The Inspector.
- RECORDING (N) appears when The Inspector is logging data to the internal memory.
- Alarm On/Off (O) indicates that the alarm has been set in the utility menu.

The Switches

The Inspector has two switches on the front and three buttons on the end panel. Each switch has three settings which are described below.

Mode Switch *Figure 2(2)*

mR/hr µSv/hr.

The numeric display shows the current radiation level in milliroentgens per hour or, when SI units are used, in microsieverts per hour.
In *mR/hr* mode, The Inspector displays the radiation level from .001 to 100.
In *µSv/hr* mode, The Inspector displays the radiation level from .01 to 1000.
See *Utility Menu* in Chapter 3 for details on how to switch between modes.

CPM CPS

In CPM, the display shows the current radiation level in counts per minute from 0 to 350,000. When using SI units, the display shows the radiation level in counts per second from 0 to 5000. When X1000 is shown on the display, multiply the numeric reading by 1000 to get the complete radiation level.

Total/Timer

The display shows the accumulated total of counts from 1 to 9,999,000. When X1000 is shown on the display, multiply the numeric reading by 1000 to get the complete radiation level. For details, see *Taking a Timed Count* in Chapter 3.

Off/On/Audio Switch *Figure 2 (3)*

Audio. The Inspector is on and makes a clicking sound for each radiation event detected.
On. The Inspector is operating, but audio is off.
Off. The Inspector is not operating.

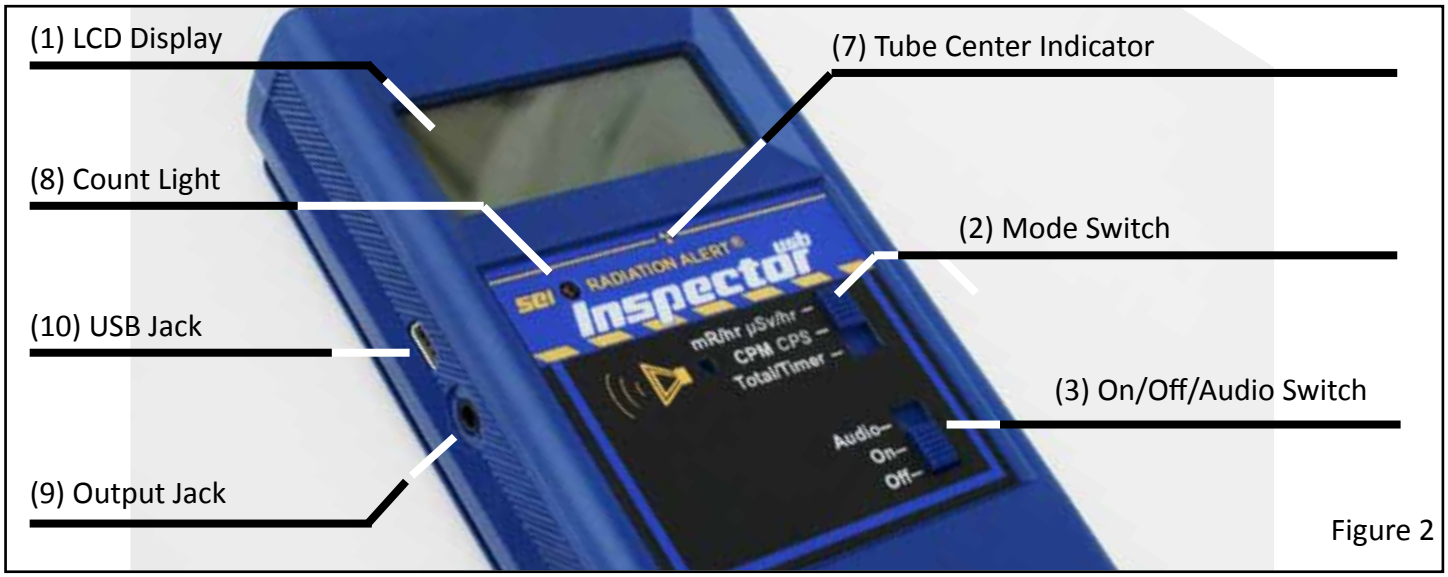


Figure 2

The Backlight

The LCD has a backlight that can be activated for the default 10 seconds by pressing the + button. The duration time of the backlight can be changed with the software. If the duration time has been changed, you can restore the default time of 10 seconds in the utility menu. See *Utility Menu* in Chapter 3 for more information on using the utility menu.

Set Button *Figure 3 (5)*
The Set button is used to set the Alert or Timer in normal operating mode and to select items in the Utility Menu. *See Chapter 3 Using the Alert, Taking a TImed Count, and Utility Menu*.

+ and - Buttons *Figure 3 (6)*
The "+" and "-" buttons are used to adjust the numeric display for timed counts, alert settings, and to make selections in the utility menu.

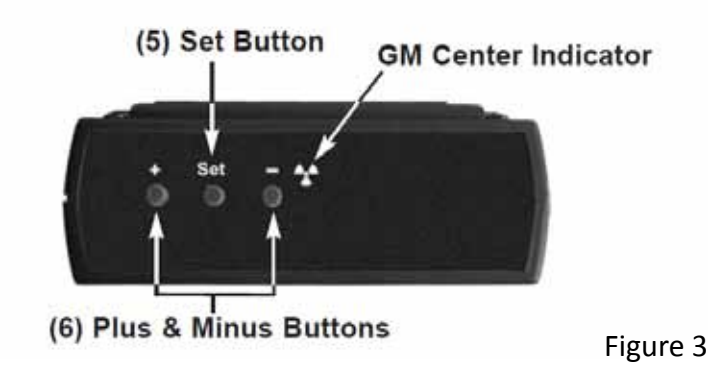


Figure 3

The Detector

CAUTION: The mica surface of the Geiger tube is fragile and should be handled with care. Be careful not to let anything penetrate the screen.

Figure 4

The Inspector uses a two-inch Geiger tube, commonly called a "pancake tube." The screen on the back of the Inspector is called the window *Figure 4 (1)*. It allows alpha and low-energy beta and gamma radiation, which cannot get through the plastic case, to penetrate the mica surface of the tube. The small radiation symbol on the front label indicates the center of the Geiger tube *Figure 2 (7)*.

The Output Ports

The Output *Figure 2 (9)*
The Output port allows you to interface the Inspector to a computer, data logger, or other device. *For details, see Interfacing to an External Device in Chapter 3.*

The USB Port *Figure 2 (10)*
The USB Port next to the Output allows you to interface The Inspector to a computer, data logger, or other device. *For details, see Chapter 7 Observer Software*.

Chapter 3: Operation

Starting the Inspector

Before starting the Inspector, install a standard 9-volt alkaline battery in the battery compartment located in the lower rear. *Note: Place the battery against the bottom wall and make sure the wires are placed along the side of the battery and not under it*.

To start the Inspector, set the top switch to the mode you want, and set the bottom switch to On or Audio. The Inspector then begins a 6-second system check. All indicators and numbers are displayed. After the system check, the radiation level is displayed in the selected mode. Approximately 30 seconds after you start the Inspector, a short beep indicates that enough information has been collected to ensure statistical validity.

Units of Measurement

The Inspector is designed for use of conventional units; milliroentgens per hour *(mR/hr)* and counts per minute *(CPM)* or SI units microsieverts per hour *(µSv/hr)* and counts per second *(CPS)*. To switch between conventional or SI units choose UNITS in the Utility Menu. For details, see *Utility Menu* in Chapter 3.

Display Update

In the dose rate modes, the numeric display is updated every 3 seconds. In Timer mode, the numeric display is updated every second.

Maximum level

When the maximum level for the current mode is reached, the Inspector beeps for three seconds, pauses for three seconds, and repeats that pattern. Also, the “RANGE:Full” icon is displayed and the numerical values displayed will show “OVER” instead of the specific rate. The beeping pattern and the flashing display continue until the level decreases or the Inspector is turned off.

Response Time (Autoaveraging)

When the radiation level is less than 6,000 CPM, the reading in any of the dose rate modes is based on the radiation detected in the previous 30 seconds. In order to give a quicker response to changes, when the radiation level exceeds 6,000 CPM in any 30 second period, the reading is based on the previous 6 seconds. When the radiation level exceeds 12,000 CPM in any 30-second period, the reading is based on the previous 3 seconds. Note: You can choose the 3 second response at any radiation level by using the *Utility Menu* detailed in Chapter 3. Refer to the following table.

After 30 second start-up if instrument is detecting	**The reading will be based on an average of the previous**
(<100 CPS) <6000 CPM or <1.75 mR/hr	30 seconds
(100 -200 CPS) 6000-12,000 CPM or 1.75-3.6 mR/hr	6 seconds
(>200 CPS) >12,000 CPM or >3.6 mR/hr	3 seconds fast response

Autoranging

When radiation levels increase in some modes over certain preset levels, The Inspector uses autoranging, automatically changing to the X1000 scale. Whenever X1000 is shown above the numeric display, multiply the displayed reading by 1000 to determine the radiation level. mR/hr, µSv/hr, and CPS are not applicable.

Mode		Ranges as they are displayed
CPM	0 to 2,999 CPM	> 2,999 X1000 3.000 (3,000) CPM to 350 (350,000) CPM
Total/Timer	0-9,999 counts	> 9,999 X1000 10.00 (10,000) to 9999 (9,999,000) counts

Operating in Dose Rate Modes

Caution: Be sure there is no obstruction between the detector window and the source being monitored/ surveyed. Avoid making measurements with the GM window facing the sun, it could affect your readings.

When the mode switch is set to mR/hr and CPM or µSv/hr and CPS, the numeric display is updated every 3 seconds unless you are using the Timer mode. At low count rates, significant changes in the radiation level displayed can take up to 30 seconds to stabilize. For details, see Autoranging" in this chapter.

CPM, CPS, and total counts are the most direct methods of measurement.

mR/hr andµSv/hr are calculated using a conversion factor optimized for Cesium^{137}. This mode is less accurate for radionuclides other than Cs^{137}, unless you have calibrated The Inspector for the specific radionuclide you are surveying.

The most immediate indicators of the radiation level are the audio and count light.

Operating in Timer Mode

When the mode switch is set to Timer, the numeric display is updated twice a second and totaling starts.

Taking a Timed Total Count

The Inspector can give you a total count for a timed period from 1 minute (10 min default) to 24 hours. A timed total count is useful for determining the average counts per minute over a period of time. The number of counts detected by The Inspector varies from minute to minute due to the random nature of radioactivity. When a count is taken over a longer period, the average count per minute is more accurate, and any small increase is more significant.

Taking an average allows you to detect low-level contamination or differences in background radiation due to altitude or soil mineral content. For example, if one 10-minute average is 1 count higher than another 10-minute average, the increase may be due to normal variation. But over 12 hours, a 1 count increase over the 12 hour background average is statistically significant.

To take a timed count, follow these steps:

1. With The Inspector operating, set the Mode switch to Total/Timer. The display shows *0* and *Total* in the upper left portion of the display.

2. Press the *SET* button on the end panel to set the time for your count. You will see the hourglass, and the most recent timing period used. The first time you use the timer, the setting is 00:10 (ten minutes).

3. Use the + and - buttons to set the timing period. The timed period can be for 1 to 10 minutes in one-minute increments, for 10 to 150 minutes in 10-minute increments, or for 1 to 24 hours in 1 hour increments.

4. Press the *SET* button. The Inspector starts totaling the counts it registers, and the numeric display is updated each time a count is registered. The hourglass indicator flashes during the timed period. During the counting period, if you want to see how many minutes remain, press the Set button. The display counts down from the time setting in hours and minutes to zero. For example, if the display shows 00:21, then 21 minutes remain.

5. At the end of the timed period, The Inspector beeps 3 times and repeats the beeping 3 times. The number displayed is the total count.

6. To find the average dose rate for the timed period, divide the total by the number of minutes. The average count is in counts per minute. To convert to mR/hr for Cesium-137, divide by 3340.

7. Move the Mode switch to one of the dose rate modes to return to normal operation. If you move the Mode switch to one of the dose rate modes while The Inspector is taking a timed count, the timed count will continue.

8. To reset the timer to take another timed count, press the *SET* button to set the time for another count.

9. Press the *SET* button a second time and The Inspector will start totaling the counts it registers, and the numeric display is updated each time a count is registered.

Using Dose Rate Modes While Timer is On

Dose rate modes can be used while the timer is on. In any dose rate mode, the hour glass indicator will continue to flash during a timed period. At the end of the timed period, the hour glass will remain continuously on, and the Inspector will beep 3 times and repeat 3 times. The timed count can be displayed by returning to the Timer mode from other modes.

Using The Alert

The Alert can be set in all modes. When using Utility Menu option “UNITS” to switch units of measurement, the alert is reset to the default alert level of .1 mR/hr (1.0 µSv/hr). Once the alert threshold is reached the beeper will sound until the alert is deactivated, or the radiation level drops below the set alert threshold.

1. To set the Alert, press the “SET” button on the end panel. The “ALERT” icon (radiation symbol) and the “SET” icon are displayed.
2. Use the “+” and “-” buttons to adjust the display to the desired level.
3. Press the “Set” button once to retain the setting in memory and activate the alert. The “ALERT” icon (radiation symbol) icon is now displayed to indicate the unit is operating in the Alert mode.
4. To deactivate the Alert mode, press the “Set” button again. The “ALERT” icon is no longer displayed.
5. To use the previous alert setting, press the set button twice. Now the alert mode is on.

Utility Menu

The Utility Menu allows the user to change default settings for several operating parameters. Once a setting is changed, it remains in effect unless they are changed through the Utility Menu.

1. To activate the Utility Menu, hold down the *+* button on the end panel while turning the instrument on. The display will show the *MENU* icon. Release the *+* button and *donE* will appear along with the *Menu* icon.
2. Scroll through the menu by pushing the *+* or - buttons.
3. To select an option, push the *SET* button and the *SET* icon is displayed.
4. Use the *+* or - buttons to toggle between choices and press the *SET* button to enter the new value. The instrument will continue to operate in the Utility Menu mode, and the display will show *DONE* and *MENU*. To adjust another Utility Menu option, repeat the above steps.
5. To exit the Utility Menu at any time, press the SET button again when *DONE* is displayed. The Inspector continues with the normal start-up routine.

See options in the table below:

Options	Function	Comments
dLoG	Data Logging	Turns on or off the data logging feature for storing collected readings in the internal memory.
UNIT	Unit of Measurement	Selects between mR/hr and CPM or µSv and CPS
EFF	Efficiency	Displays the efficiency for the pre-programmed isotopes built into The Inspector.
AVEr	Averaging	Turns Auto-Averaging on and off
CLOC	Clock	Sets the internal clock on The Inspector for use with the data logging feature.
dEF	Default Settings (Does not change calibration)	Set the unit to the default settings *(Alarm off, Cal factor 100, Auto Averaging on, mR/hr &CPM, recording off, clears and resets isotopes and backlight time)* and exits the Utility Menu
VEr	Version	Displays the firmware version
USE	Use specific isotope efficiency	If surveying a known isotope, select from the list of isotopes efficiencies to display activiy in Bq or DPM
donE	Done	Press the select button when “donE” is displayed to exit the menu and begin taking readings.

Setting the Internal Clock
To set the internal clock, enter into the utility menu, select CLOC, and press set.
1) First, the seconds are displayed. Use the + and - buttons to select the seconds for the clock and press *SET* to select your choice.
2) Second, the time will be displayed. First select the minutes and press *SET*. You will then select the hour and press *SET* again.
3) Third, the date will be displayed. First set the day and press *SET*. Then select the month and press *SET*.
4) Lastly, the year will be displayed. Select the appropriate year and press *SET*.
You will now see donE displayed in the Utility Menu. You can now select another item in the Utility Menu or press *SET* to enter into the normal function of the Digilert200.

Interfacing to an External Device

The USB jack (Figure 2(10)) on the left side of the Inspector provides a data output for use with the Observer Software. You can use it to record the counts on a computer, download the recorded data, and calibrate the instrument.

Visit seintl.com for more information on Observer Software.

Chapter 4: Common Procedures

The following sections give instructions for several commonly-used procedures. With any procedure, the user must determine the suitability of the instrument or procedure for that application.

Establishing the Background Count

Normal background radiation levels vary at different locations, time, even in different areas of the same room. To accurately interpret the readings you get on the Inspector, it is good to establish the normal background radiation count rate for each area you plan to monitor. You can do this by taking a timed count. For more information on using the timer, see “Taking a Timed Count” in Chapter 3.

A 10-minute average is moderately accurate. You can repeat it several times and see how close the averages are. To establish a more accurate average, take a 1 hour timed count. If you need to determine whether there is prior contamination, take averages in several locations, and compare the averages.

Environmental Area Monitoring

You can keep the Inspector in CPM or mR/hr mode whenever you want to monitor the ambient radiation, and look at it from time to time to check for elevated readings.

If you suspect an increase in ambient radiation, use the timer and take a 5 or 10 minute count, and compare the average to your average background count. If you suspect an increase that is too small to detect with a short timed reading, you can take a longer count (for example 6, 12, or 24 hours).

Checking for Surface Contamination

To check a surface, hold the detector window close to the surface, and read the count rate (wait 30 seconds or until the reading has stabilized). If you want to find out if a surface is slightly radioactive, take a timed count or a longer accumulated count.

Chapter 5: Maintenance

The Inspector requires regular calibration and careful handling to assure good measurements. Use the following guidelines to maintain the instrument properly.

Calibration

The Inspector should be calibrated as often as your regulations require, or in any case, at least once every year or two. The best way to calibrate is using a calibrated source at a calibration lab. However, if no source is available, it is possible to calibrate electronically using the calibration software, s*ee Chapter 8 for more info*.

The standard radionuclide for calibration is Cesium-137. A certified calibration source should be used. To calibrate the Inspector for another radionuclide, use a calibrated source for that radionuclide or the appropriate conversion factor referenced to Cs-137. CAUTION: Errors can occur when using low level sources or background for calibrating. In the Calibration mode, the smallest increment which can be adjusted is .010.

If you would like more information about source calibrations, please contact us at 1.800.293.5759 or go to seintl.com/services.

General Maintenance Tips

1. Do not get the instrument wet.
2. Be sure to store the meter in a location without direct sunlight, as sunlight can damage the end window of the detector over time.
3. Be sure to store the unit inside the carrying case when not in use.
4. If you are planning to store the unit for a long time, remove the battery to avoid battery corrosion inside the battery compartment.
5. Do not place the unit inside a microwave oven as it can damage the unit and/or the microwave. This instrument is for detecting ionizing radiation such as alpha, beta, gamma, and xrays. It will not detect non-ionizing radiation such as micrwave and radio emissions.
6. Do not place any objects that may puncture the end window of the detector near the detector end window.

Chapter 6: Basics of Radiation and Its Measurement

Ionizing radiation
Ionizing radiation changes the structure of individual atoms by ionizing them. The ions produced in turn ionize more atoms. Substances that produce ionizing radiation are called radioactive. Radioactivity is a natural phenomenon. Nuclear reactions take place continuously on the sun and all other stars. The emitted radiation travels through space and a small fraction reaches the Earth. Natural sources of ionizing radiation also exist in people and in the ground. The most common sources of ground radiation are uranium and its decay products.

Ionizing radiation is categorized into four types:

X-Rays
X-rays are manmade radiation produced by bombarding a metallic target with electrons at a high speed in a vacuum. Xrays are electromagnetic radiation of the same nature as light waves and radio waves, but at extremely short wavelength, less than 0.1 billionth of a centimeter. They are also called photons. The energy of X-rays are millions of times greater than that of light and radio waves. Because of this high energy level, X-rays penetrate a variety of materials, including body tissue.

Electromagnetic radiation (photons) of higher frequency and energy than visible and ultraviolet light. X-rays are photons emitted by interactions involving orbital electrons rather than atomic nuclei. X-rays and gamma rays have the same basic characteristics. The only difference between them is their source of origin.

Gamma Rays
Gamma rays are almost identical to X-rays. Gamma rays generally have a shorter wavelength than X-rays. Gamma rays are very penetrating and thick lead shielding is generally required to stop them.

Short wavelength electromagnetic radiation higher in frequency and energy than visible and ultraviolet light. Gamma rays are emitted from the nucleus of an atom. These high energy photons are much more penetrating than alpha and beta particles.

Beta Radiation
Beta radiation A beta particle consists of a negatively charged electron emitted from an atom. It has more mass and less energy than a gamma ray, so it doesn't penetrate matter as deeply as gamma and X-rays.

Beta particles have a mass and charge equal to that of an electron. They are very light particles (about 2,000 times less mass than a proton) and have a charge of -1. A few millimeters of aluminum will stop most beta particles.

Alpha Particles
Alpha radiation is a particle that consists of two protons and two neutrons, the same as the nucleus of a helium atom.

Positively charged particles emitted from the nucleus. Alpha particles are relatively large, and very heavy. Due to this strong positive charge and large mass, an alpha particle cannot penetrate far into any material. It generally can travel no more than 1 to 3 inches in air before stopping, and can be stopped by a piece of paper.

Chapter 7: Observer USB Software

The Observer USB reads in Total Counts, CPM, CPS, µR/hr, mR/hr, µSv/hr and has the ability to collect, log, and perform statistical analysis on the data received. The data is displayed on a graph as well as a digital on-screen meter and can be saved or printed in various ways, including a spreadsheet format. The dwell/count time can be adjusted for each point on the graph. You can also set the length of time for the count. The on-screen meters in the software have adjustable settings as well as a settable alarm.

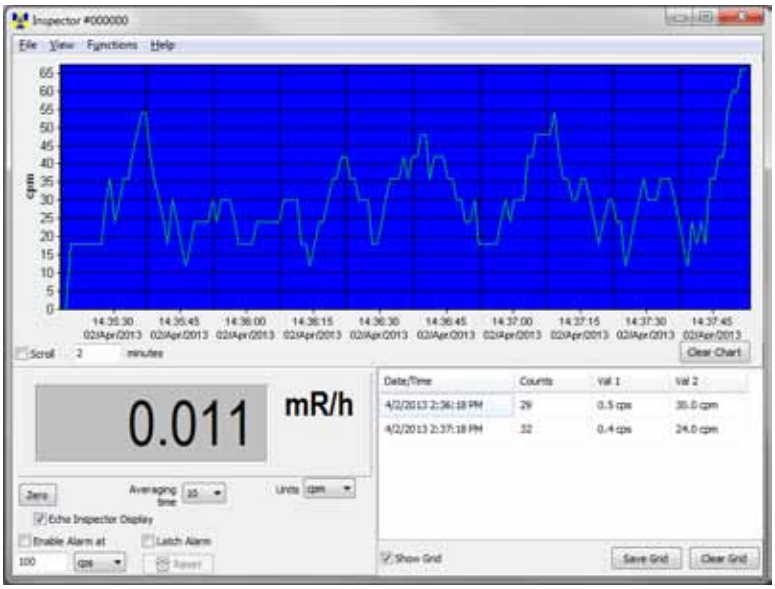
Installing the Observer USB Software

To use the Observer USB Software with your unit, you will first need to install the software prior to connecting your instrument to the computer. You can download a copy at seintl.com/software. After the software has completed downloading, double click on the installer and follow the on-screen prompts. Once the software is installed, the detector will be automatically detected and identified once the unit is connected via USB.

Connect to The Inspector

Ensure that you have installed the Observer USB Software before connecting The Inspector. The USB port is a mini-B type jack located on the side of The Inspector above the Cal Output, *see Figure 2 (9)*. To connect The Inspector, power on your detector, plug the cable into the USB jack and connect the other end to the USB port on your computer.

Once the unit is connected, the Observer Software will launch and open a window for the instrument with a serial number displayed in the upper left corner of the title bar. A new window will open for each detector connected.



Preferences

The alarm settings, auto-save chart feature, and the grid settings for datalogging frequency and units of measurement can be adjusted in View > Preferences menu.

Retrive Memory

If the recording feature on The Inspector is activated, then the collected data can be retrieved from the unit's internal memry by selecting Functions > Retrieve Memory. Data is stored in a text delimited file for easy opening in your preffered spreadsheet software.

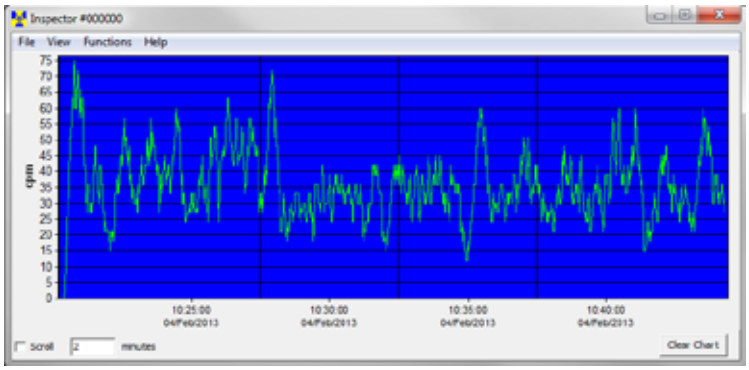
Synchronize Inspector to PC Clock

In addition to being able to set the time via the utility menu, the internal clock of The Inpector can be set to the time setting of the PC you are using. Functions > Synchronize Inspector to PC Clock. The Inspector will beep twice once synchronization has completed. The update will be recorded in the on board memory if the recording feature is on, *see Chapter 3: Operation, Utility Menu for information on activating the recording feature.*

Show Grid

The Show Grid checkbox displays the data collected in the grid. The grid displays an ongoing collection of data based on the user selectable settings in the View > Preferences > Grid Settings dialog box. For example, if the grid setting is 60 seconds, a new data point will appear on the grid every minute.

Observer USB Chart Screen



The Observer USB Chart Screen displays a chart of the data currently collected by the attached instrument.

The X Axis

The X axis consists of the time and date stamp of the reading collected and will adjust automatically to display all of the data collected unless the Scroll checkbox is selected. If the Scroll checkbox is selected, the X axis will display the latest readings collected in the minute(s) time frame selected next to the Scroll checkbox. For example, if 2 minutes is selected in the Scroll time, then the chart will display the latest 2 minutes of data collected.

The Y Axis

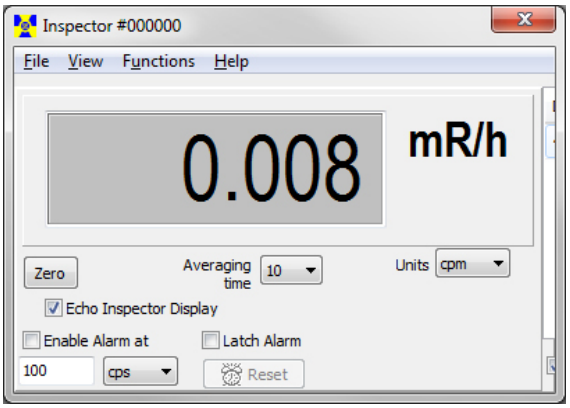
The Y axis displays the unit of measurement for the reading displayed and will automatically adjust to display the highest reading collected.

Observer USB Meter Screen

The Observer USB Meter Screen simulates an analog meter to display the readings colected by the detector.

Enable Alarm

This will enable the alarm that is built into the software. Once the radiation levels go back below the set level of the alarm, the alarm will stop unless you have the “Latch Alarm” checkbox selected.



Latch Alarm

When the latch alarm is checked, the alarm will continue to go off until the reset button is pressed.

Auto Range

When the Auto Range checkbox is selected, the analog meter will automatically adjust the scale to a higher range if the reading exceeds the Scale Max.

Scale Max

The Scale Max labels the highest reading on the scale for the range being displayed.

Zero

When the Zero is clicked, the averaging of the collected counts starts over.

Units

The Units dropdown box selects the unit of measurement displayed on the analog meter.

Averaging Time

The Averaging Time selects the amount of time in which the previous readings are averaged for a more accurate display of the collected counts.

Chapter 8: Observer USB Calibration Software

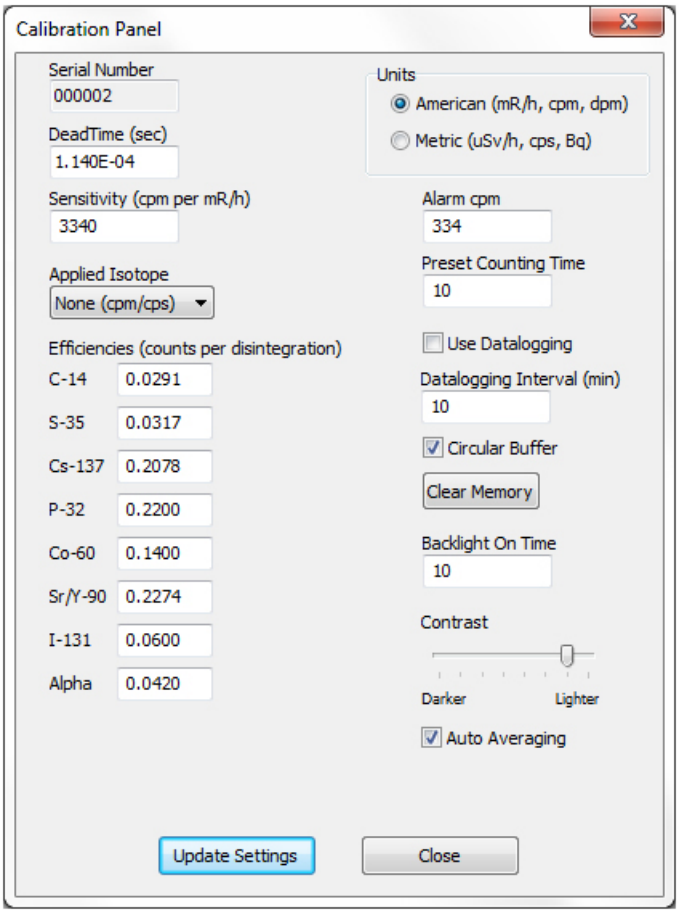
General Discussion of Calibration

In order to have confidence in the measurements taken with a radiation detection instrument, a calibration must be performed. The calibration compares the response of the instrument to known values and the instrument is adjusted (if needed) to bring all indications within the range of the instrument to within ±10% of the true values. Generally, radiation detection instruments should be calibrated annually.

CAUTION: Errors can occur when using low level sources or background for calibrating. In the Calibration mode, the smallest increment which can be adjusted is .010.

Pulse Calibration

Since GM-based instruments are essentially pulse counters, it must be verified that the number of counts reported equals the number of counts input. This should be demonstrated for both count rates and total counts. The issue is confused somewhat with the addition of dead-time compensation where the number of counts in any given second is adjusted upward to account for pulses "lost" during the time the detector is busy recharging from a pulse.



All calibration factors must be entered using the Observer USB software.

Requirements

You will need a PC running Observer USB and a Pulse generator

Procedure

1. With the instrument powered off, remove the back of the unit and attach a pulse generator to the unlabeled test point immediately to the left of U2. Pulses must be positive with a duration of approximately 2 to 20 µs. No high voltage is connected to this test point. It is also recommended that the anode of the GM tube be disconnected.
2. Power on the instrument.
3. Connect the instrument to the PC running Observer USB using the USB cable. An application window for the attached instrument should open within a few seconds.
4. Go to *View > Cal Panel* menu of The Observer USB Software to acess the Calibration Screen.
5. Record the currently displayed dead time. *(Default is 1.8E-4 seconds.)*
6. Change the dead time to 0 and click the Update Settings button. After a second or two the instrument should beep twice to acknowledge that the new setting has been received, stored, and applied. Setting the dead time to 0 seconds causes the device to not apply any dead-time correction at all, so the display should report the true input pulse rate.
7. Run the pulse generator at several different rates to span the range of the instrument. The maximum intended working pulse rate for the Digilert 200 is about 125,000 cpm (2,000 Hz). For the Inspector, the maximum working input pulse rate should be about 500,000 cpm (8,333 Hz). Verify that the value reported by the instrument is within ±10% of the input value in all cases.
8. Change the dead time back to the setting recorded in Step 5.

Efficiency Calibration

The Inspector can be used beyond simple detection of contamination and can also be used to determine the activity of beta- or alpha-emitting isotope present.

Efficiency is the ratio of events detected by the instrument to the number of decays of the particular isotope. The units are therefore counts per disintegration of c/d. Since efficiencies are generally somewhat less than one, they are often multiplied by 100 and expressed as a percentage. However, the Observer USB software requires that values not be entered as percentages. Since efficiency varies based on the energy and abundance of the particular isotope being measured, it is best to determine efficiency for the specific isotope(s) for which the activity is to be determined.

The efficiency is also affected by the size of the source and the source to detector distance. To achieve consistency, efficiencies should be determined using a point source (which means a source with an area significantly smaller than the detector entrance window) at a fixed distance from the detector face (which must be specified, but 1 cm will be assumed to be the standard).

Requirements

You will need a PC running Observer USB, Calibration sources, an Inspector Wipe Test Plate (or other constant-geometry source holder to maintain sources 1 cm from the detector entrance window)

Procedure *(American Units)*

1. Attach the Wipe Test Plate to the Inspector. Ensure The Inspector is in Total/Timer mode, displaying COUNTS.
2. Place the Inspector in the location where the efficiency calibration will be performed and take a count of at least ten minutes. Divide the total number counts by the acquisition time (in minutes) to calculate the background counting rate (RB) in cpm. Record this value.
3. Center the first source to be used into the Wipe Test Holder and take a count of at least one minute. Divide the total number of counts by the counting time (in minutes) to calculate the gross count rate (gcpm or RG).
4. Calculate the efficiency using the following equation:

$$Eff = \frac{(R_G - R_B)}{A}$$

Where
Eff is instrument efficiency in counts per disintegration
RG is the gross count rate in counts per minute (cpm)
RB is the background count rate in cpm
A is the activity of the source in disintegrations per minute (dpm)

5. Repeat Steps 3 and 4 for additional radionuclides.
6. If you would like to record efficiency values in the Inspector's memory for any of the supported radionuclides (14C, 35S, 137Cs, 32P, 60Co, 90Sr/90Y, 131I, ALPHA), continue with the following steps.
7. Connect the Inspector to the PC running Observer USB using the USB cable. An application window for The Inspector should open within a few seconds.
8. Display the control panel by clicking View|Cal Panel…
9. Enter the updated efficiencies in the appropriate fields.
10. If you would like the Inspector to display in activity units (i.e., DPM) for a specific source instead of the count rate (CPM), select it from the Applied Isotope dropdown box. Otherwise, leave as None (cpm/cps).
11. When all relevant values have been updated, click the Update Settings button. After a second or two the Inspector should beep twice to acknowledge receiving the updated settings.

Procedure (Metric Units)

1. Attach the Wipe Test Plate and power on the Inspector. Make sure the Inspector is in Total/Timer mode, displaying COUNTS.
2. Place the Inspector in the location where the efficiency calibration will be performed and take a count of at least ten minutes. Multiply the acquisition time by 60 to convert it from minutes to seconds. Divide the total number counts by the acquisition time (in seconds) to calculate the background counting rate (RB) in cps. Record this value.
3. Center the first source to be used into the Wipe Test Holder and take a count of at least one minute. Divide the total number of counts by the counting time (in seconds) to calculate the gross count rate (gcps or RG).
4. Calculate the efficiency using the following equation:

$$Eff = \frac{(R_G - R_B)}{A}$$

Where
Eff is instrument efficiency in counts per disintegration
RG is the gross count rate in counts per second (cps)
RB is the background count rate in cps
A is the activity of the source in disintegrations per second (dps) or becquerels (Bq)

5. Repeat Steps 3 and 4 for additional radionuclides.
6. If you would like to record efficiency values in the Inspector's memory for any of the supported radionuclides (14C, 35S, 137Cs, 32P, 60Co, 90Sr/90Y, 131I, ALPHA), continue with the following steps.
7. Connect the Inspector to the PC running Observer USB using the USB cable. An application window for the Inspector should open within a few seconds.
8. Display the control panel by clicking View|Cal Panel…
9. Enter the updated efficiencies in the appropriate fields.
10. If you would like the Inspector to display in activity units (i.e., DPM) for a specific source instead of the count rate (CPM), select it from the Applied Isotope dropdown box. Otherwise, leave as None (cpm/cps).
11. When all relevant values have been updated, click the Update Settings button. After a second or two the Inspector should beep twice to acknowledge receiving the updated settings.

Exposure Rate Calibration

An exposure rate calibration correlates the number of counts in given time to the exposure rate present in that field. This is in many ways similar to efficiency but we refer to it in this case as gamma sensitivity. Although it is possible to express this value in several different units, the Inspector requires the use of cpm per mR/h (counts per minute per milliroentgen per hour).

The instrument is placed in gamma radiation fields of different (but known) intensities that span the working range of the instrument, and the settings adjusted (if needed) such that all measurements are within ±10% of the true value. The relevant settings include both the sensitivity and the dead time.

The gamma field is usually generated by a relatively strong Cs-137 source. Exposure rates are calculated to the center of the detector's volume.

Exposure Rate Calibration

Requirements

You will need a PC running Observer USB and a Gamma calibration range

Procedure

1. Power on the instrument.
2. Connect the instrument to the PC running Observer USB using the USB cable. An application window for the attached instrument should open within a few seconds.
3. Display the calibration panel by clicking View|Cal Panel…
4. Record the displayed values for Dead Time and Sensitivity.
5. Begin checking the instrument's Sensitivity. Place the instrument in a relatively low field, approximately 5 mR/h, and allow it 30 seconds or so to stabilize.
6. If the indicated response is off by more than 3% at this level, adjust the Sensitivity to a lower value if the instrument is reading too low, or to a higher value if the instrument is reading too high. After changing the value on the Calibration Panel, click the Update Settings button. After a second or two the instrument will beep twice to indicate that the new value has been received.
7. Repeat Step 5 as needed to bring the instrument indication as close as possible to the true value.
8. Next, expose the instrument to a field near the top of its range—around 200 mR/h for the Digilert 200 or 100 mR/h (???) for the Inspector. Allow the reading to stabilize for at least six seconds.
9. If the indicated response is off by more than 10%, adjust the Dead Time to a lower value if the instrument is too low, or to a higher value if the instrument reading is too high. After changing the value on the Calibration Panel, click the Update Settings button. After a second or two the instrument will beep twice to indicate that the new value has been received.
10. Repeat step 9 as needed to bring the instrument's indication within ±10% of the true value.
11. Once the values for Sensitivity and Dead Time have been verified to be correct, expose the instrument to a series of values spanning the range of the instrument. All indications should be within ±10% of the true value.

Chapter 9: Built in Isotope Efficiencies

Built in Isotope Efficiencies

The Inspector has a number of built in efficiencies for specific isotopes. If you know the isotope being surveyed, then you can select one of the pre-programmed isotope efficiencies to calculate the activity of your known source. The activity *(DPM and Bq)* is different from the rates of exposure *(mR/hr, µSv/hr, CPM, and CPS).* Activity is the number of disintegrations of a radioactive substance in a given unit of time, which is specific to the isotope being detected. *Caution: Do not use the built in efficiencies unless you are surveying a known isotope, as doing so will give you inaccurate results.*

Decay

When an atom emits an alpha or beta particle or a gamma ray, it becomes a different type of atom. Radioactive substances may go through several stages of decay before they change into a stable, or non-ionizing, form. For example; U-238 has 14 different stages of decay before it stabilizes.

An element may have several forms, or isotopes. A radioactive isotope of an element may be called a radioisotope. However, the more correct term is radionuclide.

Selecting a Built-In Isotope Efficiency

Enter the Utility Menu and scroll to the “USE” menu item and press “SET” on the end panel of the unit to select the isotope efficiency you want to use for your survey. For example, if you know you are surveying Iodine 131, then you would select I131 from the menu. Once you have selected the cooresponding isotope, press the “SET” button to select it. Press “SET” again to begin normal operation of The Inspector.

You can select from any of the following isotope efficiencies built into the Inspector: ^{35}Sulfur (S35), ^{90}Strontium (Sr/y90), ^{137}Cesium (Cs137), ^{32}Phosphorus (P32), ^{14}Carbon (C14), ^{131}Iodine (I131), ^{60}Cobalt (Co60), and Alpha.

Selecting Between DPM and Bq

Enter the Utility Menu and scroll to the “UNIT” menu tiem and press “SET” on the end panel of the unit to change the units of measurement between DPM (when mR/hr and CPM are selected) and Bq (when µSv/hr and CPS are selected).

Chapter 10: Troubleshooting

The Inspector is a highly reliable instrument. If it does not seem to be working properly, look through the following chart to see if you can identify the problem.

Problem	Possible Cause	Action
Display works, but no counts are registered	defective Geiger tube or bad cable	look through the window to check the mica surface of the tube; if it is wrinkled or a break is visible, replace it check EXP cable Connection
Reading is high, but another instrument has a normal reading in the same location	possible contamination	scan the Inspector with another instrument. You may need to replace the rubber strips on back of Inspector
Instrument has false high reading	moisture	circuit board may be wet; dry the instrument in a warm dry place; if it still has a problem, it requires service
Instrument has false high reading	photosensitivity	remove from direct sunlight and ultraviolet sources; if the high count drops, the mica window coating may have washed off the Geiger tube due to getting wet; the tube will need to be replaced
Instrument has false high reading	continuous discharge	replace the Geiger tube
Instrument has false high reading	electromagnetic field	move the instrument away from possible sources of electromagnetic or radio frequency radiation
Display is blank	no battery, dead battery, poor battery connection defective LCD	install a new 9-volt battery *(if count light and audio work, the LCD may need to be replaced)*

Chapter 11: Basics of Taking Measurements

The Inspector will not detect neutron, microwave, RF (radio frequency), laser, infrared, or ultraviolet radiation. All of our instruments are most accurate for Cesium 137 and isotopes of similar energies. Some isotopes detected relatively well by most Geiger counters are Cobalt 60, Technicium 99M, Phosphorous 32, Strontium 90, and many forms of Radium, Plutonium, Uranium, and Thorium.

Some forms of radiation are very difficult or impossible for a Geiger tube to detect. Tritium, for example, is a byproduct of a nuclear reactor and is used in research. The beta emissions from Tritium are so weak that there are very few instruments that are capable of detecting it. More sophisticated equipment is needed for the measurement of environmental samples, such as radioactivity in milk, produce, soil, etc., unless you are looking for gross contamination.

The radiation from some isotopes can cause a Geiger tube to overexcite and indicate a higher level of radiation than is actually present. Americium 241 is an example of this phenomenon. Americium 241 is used in some smoke detectors and many different types of industrial density and flow meters.

Unless you know exactly what you are measuring and understand the limitations of detection instruments, it is possible to draw misleading conclusions from your readings. We design our instruments to detect the broadest range of ionizing radiation possible and still be affordable. The full spectrum of ionizing radiation cannot be measured by one single instrument. Everyone agrees that radioactive materials can be dangerous. We encourage you to seek out other sources of information.

How to Detect Background Radiation
To see what the background radiation is in your area, simply turn the intrument on and, after the 30 second start up beep, the general background radiation will be displayed.

How To Survey a Surface
When surveying a surface, such as a counter top, you will need to hold The Inspector about 1-2 centimeters from the surface while moving the unit horizontally across the survey area at a rate of 2 inches per second.

How to Perform a General Survey
A general survey would be used to find a potential source. For example, if you are looking for a potential source in a pile of scrap, The Inspector will typically detect about 2 feet into a pile. It is easier to find a source when The Inspector is set to Fast Response mode. However, even if The Inspector is in Auto-Averaging mode, the audio clicks that indicate a count should be a sufficient indicator if a potential source is present. To find the source, slowly move The Inspector in the direction of the higher readings or clicks until the potential source is found.

Geiger counters can detect the four main types of ionizing radiation: alpha, beta, gamma, and x-rays. Some detect only gamma and x-rays. Our instruments are calibrated to Cesium 137, but also serve as excellent indicators for many other sources of ionizing radiation. Gamma and x-rays are measured in milli-Roentgens per hour (mR/hr), micro-Sieverts (µSv/hr), or milli-Sieverts (mSv/hr). Alpha and beta are measured in counts per minute (CPM) or counts per second (CPS).

The window of the GM tube is very thin mica. This mica window is protected by a screen. Some levels of alpha, low energy beta, gamma, and x-rays that cannot penetrate the plastic case or the side of the tube can be sensed through the window.

Try not to touch the instrument to any suspected radioactive substance.

Although some beta and most gamma radiation can go through protective gear, try to avoid skin contamination and ingestion. When you leave a radioactive area, remove any protective outerwear and dispose of it properly. If you think you have been contaminated, as an additional precaution, shower and consult a physician.

How to Determine Alpha, Beta, or Gamma source.

To determine whether the radiation detected is alpha, beta, or gamma, hold the instrument toward the source.

Alpha: If there is no indication through the back of the case (the side of the tube), position the window close to but not touching the source. If there is an indication, it is alpha, beta, or low energy gamma. If a sheet of paper placed between the window and the source stops the indication, it is most likely alpha. To avoid particles falling into the instrument, do not hold the source above the window.

Beta: Place a piece of aluminum about 1/8 inch (3 mm) thick between the instrument and the source. If the indication stops, decreases, or changes, it is most likely beta radiation. Most common isotopes emit both beta and gamma radiation. This is why the indication would decrease or change but not stop.

The non-occupational dose limits set by the government is 100 mR above background annually.

It is up to the individual to decide what a safe radiation level is. It will be different depending on the individual and their knowledge of radiation and its affects. Radiation levels will vary according to location and circumstances. As an example; if your background level is 25 CPM (counts per minute) where you live, when you fly in an airplane at 30,000 feet your rate meter may measure 200 CPM (.2 mR) for 2 to 5 hours. That is 8 times your normal background radiation on the ground, but it is only for a limited amount of time.

When measuring radiation in an emergency response situation, it is good to have something to compare your readings to. Taking a background radiation level reading in your area before a radiation event will help you determine if you have an elevated level of radiation and whether or not to stay in that location. Background radiation is naturally occurring radiation that is always present. It includes; high energy gamma rays from the sun and outer space and alpha, beta, gamma radiation emitted from elements in the earth. Using a rate meter, you can determine your normal background radiation levels.

Gamma and X-Rays: If there is an indication of radioactivity, it is most likely gamma or high energy beta. Low energy gamma and x-rays (10-40 keV) cannot penetrate the side of the GM tube, but may be detected through the window.

If you perform the alpha/beta test above and there is no change or only a very slight change in the indication, the source is emitting primarily gamma radiation.

Radiation Measurement Units
Several different units are used to measure radiation, exposure and dosage.

A Roentgen is the amount of X-radiation or gamma radiation that produces one electrostatic unit of charge in one cc of dry air at 0° C and 760 mm of mercury atmospheric pressure. One thousand milliroentgen (1,000 mR)= 1R. The Inspector displays in milliroentgens per hour (mR/hr).

A Rad is the unit of exposure to ionizing radiation equal to an energy of 100 ergs per gram of irradiated material. This is approximately equal to 1.07 roentgen.

A Rem is the dosage received from exposure to a rad. It is the number of rads multiplied by the quality factor of the particular source of radiation. The rem and millirem are the most commonly-used measurement units of radiation dose in the U.S. 1 rem= 1rad.

A Sievert is the standard international measurement of dose. One sievert is equivalent to one hundred rems. A microsievert (µSv) is one millionth of a sievert. A unit of dose equivalent. 1 Sv= 100 roentgens, 10 µSv/hr = 1 milliroentgen/hr.

A Curie is the amount of radioactive material that decays at the rate of 37 billion disintegrations per second, approximately the decay rate of one gram of radium. Microcuries (millionths of a curie) and picocuries (trillionths of a curie) are also often used as units of measurement.

A Becquerel (Bq) is defined as the activity of a quantity of radioactive material in which one nucleus decays per second. 1 dps (one disintegration per second).

Converting CPM to mR/hr

$$\text{mR/hr} = \frac{\text{cpm}}{\text{sensitivity}}$$

Sensitivity is expressed in cpm per mR/h (Counts Per Minute for every milliRoentgen the GM tube can detect) referenced to Cs137. Mathematically the cpm units cancel each other out leaving mR/h, as shown below.

$$\frac{\text{cpm}}{\frac{\text{cpm}}{\cancel{\text{mR/hr}}}} = \frac{\text{cpm}}{1} \times \frac{\text{mR/hr}}{\text{cpm}} = \text{mR/hr}$$

For example, if you have collected 200CPM with the Radiation Alert Inspector, which has a typical gamma sensitivity of 3340 cpm per mR/hr, you would divide the 200 cpm by the 3340 cpm per mR/hr sensitivity. The cpm cancels out and you are left with 200/3340mR/hr = 0.057 mR/hr

$$\frac{200\ \text{cpm}}{3340\ \frac{\text{cpm}}{\cancel{\text{mR/hr}}}} = 0.057\ \text{mR/hr}$$

Chapter 12: Glossary of Common Terms

Background Radiation
Naturally occurring radiation is always present, it includes high energy gamma rays from the sun and outer space and alpha, beta, and gamma radiation emitted from elements in the earth.

CPM (counts per minute)
The unit of measurement usually used to measure alpha and beta radiation.

Ion
An atomic particle, atom, or molecule that has acquired an electrical charge, either positive or negative, by gaining or losing electrons.

Ionization
The process by which neutral atoms of molecules are divided into pairs of oppositely charged particles known as ions.

Ionizing Radiation
Radiation capable of producing ionization by breaking up atoms or molecules into charged particles called ions.

Radiation
The emission and propagation of energy through space or through matter in the form of particles or waves.

Radionuclide
The naturally occurring or artificially produced radioactive form of an element.

Decay
When an atom emits an alpha or beta particle or a gamma ray, it becomes a different type of atom. Radioactive substances may go through several stages of decay before they change into a stable, or non-ionizing, form. For example; U-238 has 14 different stages of decay before it stabilizes. An element may have several forms, or isotopes. A radioactive isotope of an element may be called a radioisotope. However, the more correct term is radionuclide.

Half-life
Each radionuclide has a characteristic half-life, which is the time required for half of a quantity of the material to decay.

Chapter 13: Accessories

Xtreme Boot

The Xtreme boot offers maximum performance in a lightweight rugged solution for using Radiation Alert® products in the field. The Xtreme boot is designed specifically for individuals operating in tough environments, such as 1st Responders, Mining and HAZMAT crews. Made of a RoHS compliant TPE rubber, the case also offers superior grip and drop protection. When using the pancake detector, a protective door opens on the back of the case exposing the end window of the GM for alpha detection.

Stand

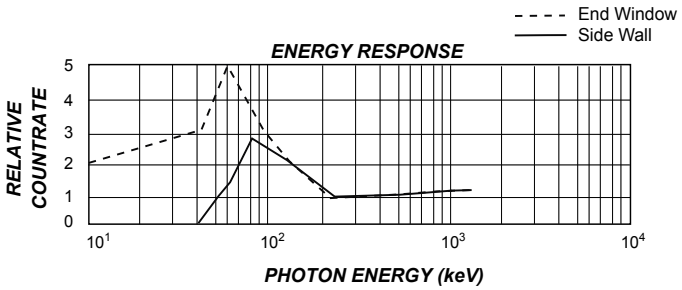
Whether you need to perform area monitoring or scan your hands and items for contamination, the STAND offers a convenient way for the instrument to STAND vertically while leaving your hands free for other tasks. The STAND is made from electro-polished stainless steel. Double stick adhesive strips are included to mount the STAND in a permanent location.

Appendix A: Specifications

Detector
Internal Halogen-quenched, uncompensated GM tube with thin mica window, 1.4-2.0 mg/cm2 areal density. Effective diameter of window is 45 mm (1.77 in.). Radiation symbol on front label marks the center of the detector.

Averaging Periods
Display will update every 3 seconds. At low background levels, the update is the moving average for the past 30-second time period. The timed period for the moving average decreases as the radiation level increases.

Operating Range
mR/hr - .001 (1µR) to 100 CPM - 0 to 350,000
µSv/hr - .01 to 1000 CPS - 0 to 5000
Total/Timer - 1 to 9,999,000 counts



Accuracy (Cs^{137})
mR/hr ±10% typical (NIST), ±15% max - 0 to 100
µSv/hr ±10% typical (NIST), ±15% max - 01 - 1000
CPM ±10% typical (NIST), ±15% max - 0 to 350,000

Energy Sensitivity
Detects Alpha down to 2 MeV. Detects Beta down to .16 MeV; typical detection efficiency at 1 MeV is approx. 25%. Detects Gamma down to 10 KeV through the end window. 3340 CPM/mR/hr (Cs^{137}). Smallest detectable level for I^{125} is .02 µCi at contact.

Display
4 digit liquid crystal display with indicators. Display updates every 3 seconds.

Alert Set Range
mR/hr .001 - 50 and CPM 1 - 160,000. 70db @ 1m.

Count Light
Red LED flashes with each radiation event.

Audio Indicator
Internally mounted beeper (can be switched off for silent operation)

Outputs
Dual miniature jack drives CMOS or TTL devices and counts to computer or datalogger.
USB for use with Observer USB Software for PCs

Anti-Saturation
Meter will hold at full scale in fields as high as 100 times the maximum reading.

Power Requirements
One 9-volt alkaline battery. Battery life is approx. 2000 hours at normal background.

Temperature Range
-10ºC to 50ºC (14ºF to 122ºF)

Weight
Inspector: 273 g (9.6 oz.) without battery.

Size
150 x 80 x 30 mm (5.9 x 3.1 x 1.2 in.).

Includes
Carrying Case, Certification of Conformance, Observer USB Software

Options
Xtreme Boot, Wipe Test Plate, & Stand

Limited Warranty
1 year limited warranty. 90 day limited warranty on GM Tube

Appendix B: Limited Warranty

WARRANTOR: S.E. International, Inc., P.O. Box 39, 436 Farm Road, Summertown, TN 38483-0039, USA, (931) 964-3561

ELEMENTS OF WARRANTY: S.E. International, Inc., warrants for 90 days the Geiger-Mueller tube and for one year all materials and craftsmanship in this product to be free from all defects with only the limitations set out below.

WARRANTY DURATION: The warranty shall terminate and be of no further effect one year (90 days on the GM tube) after the original date of purchase of the product or at the time the product is: a) damaged or not maintained as is reasonable or necessary, b) modified, c) repaired by someone other than the warrantor for a defect or malfunction covered by this Warranty, d) contaminated with radioactive materials, or e) used in a manner or purpose for which the instrument was not intended or contrary to S.E. International, Inc.'s written instructions. This warranty does not apply to any product subjected to corrosive elements, misuse, abuse, or neglect.

STATEMENT OF REMEDY: In the event that the product does not conform to the warranty at any time while this warranty is effective, the Warrantor will repair the defect and return the instrument to you prepaid, without charge for parts or labor.

NOTE: While the product will be remedied under this warranty without charge, this warranty does not cover or provide for the reimbursement or payment of incidental or consequential damages arising from the use of or the inability to use this product. The liability of the company arising out of the supplying of this instrument, or its use, whether on warranties or otherwise, shall not in any case exceed the cost of correcting defects in the instrument, and after the said one year (90 days on the tube) period all such liability shall terminate. Any implied warranty is limited to the duration of the written warranty.

PROCEDURE FOR OBTAINING PERFORMANCE OF WARRANTY: In the event that the product does not conform to this warranty, please write or call to the address above. S.E. International, Inc. will not accept contaminated instruments for calibration or repair under warranty or otherwise.

NOTE: Before using this instrument, the user must determine the suitability of the product for his or her intended use.

Calibration Database Application

Please fill out this form and send it back to us if you would like to be notified of the NIST calibration renewal for your instrument to:

S.E. International, Inc.
P.O. Box 39, 436 Farm Rd. Summertown, TN 38483
1.800.293.5759 | 931.964.3561 | Fax: 1.931.964.3564
www.seintl.com | radiationinfo@seintl.com

NAME	MODEL NAME
COMPANY	SERIAL NUMBER
ADDRESS	DATE PLACED IN SERVICE
CITY	EMAIL
STATE, ZIP, & COUNTRY	PHONE NUMBER

Or fill out the form online at

http://seintl.com/calibrations/